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Tentative

ENGINEERING REPORT
FOR
COMPARISON OF COSTS
OF
ALTERNATE LINES
OF
INTERSTATE ROUTE I-94

IN THE VICINITY
OF

LOCKWOOD

PREPARED BY
MONTANA STATE HIGHWAY COMMISSION
INTERSTATE DIVISION
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ENGINEERING REPORT FOR COMPARISON OF COSTS OF ALTERNATE LINES OF INTERSTATE ROUTE I-94
IN THE VICINITY OF LOCKWOOD

ENGINEERING REPORT
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OF
ALTERNATE LINES OF INTERSTATE ROUTE I 94
IN THE VICINITY
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LOCKWOOD

FOREWORD

This report was prepared to compare the relative merits of two alternate locations for Interstate 94 in the Lockwood district, southeast of Billings. The principle purpose here is to illustrate in monetary terms the most pertinent considerations involved. These considerations include the cost of constructing alternate routes, the cost of maintaining each route, and the cost which will be incurred by the highway user in traveling on each route.

Since the cheapest route to construct and maintain does not always provide the best service to the highway user, it is also necessary to consider vehicular operating costs in determining the route which is of the greatest overall benefit.

Federal and State funds for the support of highways are obtained almost entirely from highway-user taxes; consequently, the most favorable highway location, from the standpoint of the people who are paying for it, would be the route that has the lowest overall cost when all construction, maintenance and vehicular operating cost are taken into consideration.

THE INTERSTATE SYSTEM

The Interstate System was originally established under the Federal Aid Highway Act of 1944. It was defined as the National System of Interstate Highways. This original system was included as part of the Federal Aid Primary System, and, with minor exceptions, the system was treated the same as the Primary System.

However, the nation-wide interest in the Interstate System made it evident that it required special attention, both in financing and in expediting the construction to adequate standards to serve the anticipated great increase in traffic volumes. Action to accomplish this objective was contained in legislation as part of the Federal Aid

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Highway Act of 1956. Under this Act the name of the system was changed to the National System of Interstate and Defense Highways. It was stipulated that the Interstate System should be completed as nearly as practicable over a thirteen-year period. The national interest in the system was recognized by means of greatly increased authorizations of Federal Aid to assist in construction of the system and also in liberalization of the proportion of Federal money as compared to State money. Much higher standards were prescribed for the construction of this system and included the control of access to the highways so that traffic could move safely and expeditiously.

There are three Interstate Routes in Montana. Interstate Route 15 begins at Monida Pass at the Montana-Idaho border and generally follows US 91 northerly through Dillon, Butte, Helena, Great Falls, Conrad, and to the Montana-Canada border. Interstate Route 90 begins at Lookout Pass on the Montana-Idaho border and generally follows US 10 easterly through Missoula, Butte, Bozeman, and Billings, then southerly along US 87 from Billings through Hardin to the Montana-Wyoming border. Interstate Route 94 begins at Billings and generally follows US 10 easterly through Miles City, Glendive, Wibaux, and to the Montana-North Dakota border.

ALIGNMENT DESCRIPTION

In general, this report deals with the location of the five miles of Interstate Route 94 east of the Yellowstone River bridge at Billings.

The two feasible locations considered are designated in this report as the North Line and the South Line. From the west common terminus the North Line extends easterly through an industrial area bordering US 87. The line then extends to the east, generally parallel to and north of the Old Hardin Road through a residential development and an irrigated farming area to the east terminus. This line is 4.166 miles long.

From the west common terminus, the South Line extends in a southerly direction to a point south and west of the Lockwood School. From this point it extends to the east through a cattle-grazing area before returning to the irrigated land near the east common terminus. This line is 4.716 miles long.

DESIGN STANDARDS

The following design criteria used in this analysis are in accordance with the "Geometric Design Standards for the National System of Interstate and Defense Highways."

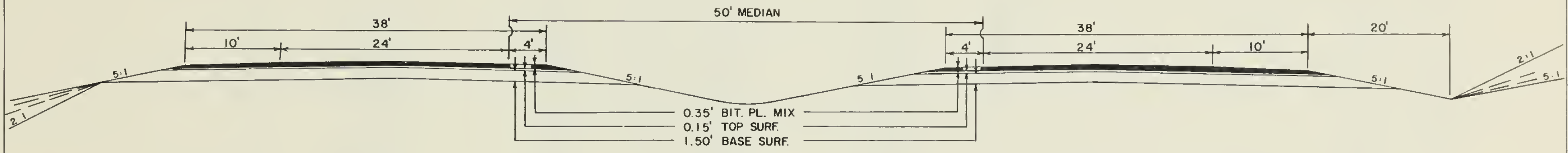
Design Speed

North Line = 70 MPH
South Line = 70 MPH

Design Hourly Volume (1975)

North Line = 750
South Line = 750

TYPICAL SECTION



FOUR LANE

Typical Section

Both the North Line and the South Line are four-lane facilities with a 50 foot depressed median.

Asphalt has been used for surfacing material on both lines. Ten foot shoulders were used on the right and four foot shoulders on the left of the travel lanes.

Maximum Horizontal Curvature

North Line = 1°00'
South Line = 2°00'

Maximum Grade

North Line = 3.0%
South Line = 3.0%

COST ESTIMATE

UTILITY ADJUSTMENT

The utility adjustments that are required for the construction of the alternate locations were determined by a field review and estimated on the basis of average unit costs.

GRADE AND DRAIN

Grades were established on profiles plotted from field surveys. Grading quantities were computed by means of curves that relate earthwork volumes to depth of cut, height of fill, and percent of cross slope. A base cost of $0.35 was used for excavation, borrow, watering, and rolling. The cost of overhaul which was determined to be $0.30 on the North Line and $0.10 on the South Line was added to this base.

The cost for drainage structures 72" or less in diameter has been calculated on a cost-per-mile basis. To determine the proper cost-per-mile, 147.6 miles of 1959 construction were examined and appropriate adjustments were made to suit this typical roadway section.

BASE AND SURFACING

The material quantities for base and surfacing courses were computed for the typical section that is proposed. The unit cost is based on the 1959 average low bid price of 18" of base material and 4" of plant mix surfacing.

STRUCTURES

Structure costs were estimated on the basis of deck area.

INTERCHANGES

Interchange costs include the structure; grading, draining, and surfacing of ramps; curbs; guardrail; and signing. Statewide average costs were used for each item.

MISCELLANEOUS

Fencing costs are included in estimates for both lines. The cost of three miles of chain-link fence is included in the North Line estimate through the more populated area in accordance with the usual practice. All other sections have standard control-access fence.

Traffic control devices are included on an average cost-per-mile.

RIGHT-OF-WAY

The right-of-way cost was estimated from a field review. It includes the cost of the property taken and the cost of severance damages.

ENGINEERING AND CONTINGENCIES

Fifteen percent of the construction cost was added for engineering and contingencies. Engineering costs include surveys, preparation of plans, and construction supervision. Contingencies are items uncertain as to occurrence and minor items not covered in this estimate.

ESTIMATE OF CONSTRUCTION COST
NORTH LINE

ITEM	UNIT	QUANTITY	UNIT PRICE	UNIT COST	ITEM COST
TOTAL UTILITY ADJUSTMENTS	Lump Sum				$ 36,696
GRADING					
MAINLINE	Cu. Yds.	899,000.	$ 0.65	$584,350	
FRONTAGE ROAD	Miles	2.1	9,610.00	20,181	
TOTAL					604,531
TOTAL DRAINAGE	Miles	4.166	11,735.00		48,888
SURFACING					
BASE (18")	Miles	4.166	42,381.00	176,559	
PLANT MIX (4")	Miles	4.166	56,716.00	236,279	
FRONTAGE ROAD (PL. MIX)	Miles	2.1	24,203.00	50,826	
TOTAL					463,664
SEPARATIONS					
PICCOLO LANE	Sq. Ft.	12,810	10.20	130,662	
COUNTY ROAD	Sq. Ft.	12,810.	10.20	130,662	
TOTAL					261,324
INTERCHANGE					
STRUCTURE	Sq. Ft.	19,620.	10.20	200,124	
GRADE & DRAIN RAMPS	Lump Sum			42,620	
BASE & SURFACE RAMPS	Lump Sum			39,239	
CURBS	Lin. Ft.	4,700.	3.16	14,852	
TRAFFIC CONTROL	Lump Sum			15,500	
TOTAL					312,335
NO BRIDGES INVOLVED					--
MISCELLANEOUS					
FENCE					
CHAIN LINK	Miles	3.000	13,780.00	41,340	
RIGHT OF WAY	Miles	5.332	2,880.00	15,356	
TRAFFIC CONTROL	Lump Sum			1,666	
TOTAL					58,362
CONSTRUCTION SUBTOTAL					1,785,800
RIGHT OF WAY	Lump Sum				972,000
ENGINEERING & CONTINGENCIES	15% Construction Subtotal				267,870
TOTAL CONSTRUCTION COST					$3,025,670

ESTIMATE OF CONSTRUCTION COST
SOUTH LINE

ITEM	UNIT	QUANTITY	UNIT PRICE	UNIT COST	ITEM COST
TOTAL UTILITY ADJUSTMENTS	Lump Sum				$ 16,810
GRADING					
MAINLINE	Cu. Yds.	979,933	$ 0.45	$440,970	
FRONTAGE ROAD	Miles	0.5	9,610.00	4,805	
TOTAL					445,775
DRAINAGE	Miles	4.716	11,735.00		55,342
SURFACING					
BASE (18")	Miles	4.716	42,381.00	199,868	
PLANT MIX (4")	Miles	4.716	56,716.00	267,473	
FRONTAGE ROAD (PL. MIX)	Miles	0.5	24,203.00	12,102	
TOTAL					479,443
SEPARATION					
HIGHWAY #87	Sq. Ft.	10,590	10.20	108,018	
JOHNSON LANE	Sq. Ft.	1,176	42.20	49,627	
BEECRAFT LANE	Sq. Ft.	1,344	42.20	56,295	
OLD HARDIN ROAD	Sq. Ft.	10,590	10.20	108,018	
TOTAL					321,958
INTERCHANGES					
STRUCTURES	Sq. Ft.	19,620.	10.20	200,124	
GRADE & DRAIN RAMPS	Lump Sum			42,620	
BASE & SURFACE RAMPS	Lump Sum			39,239	
CURBS	Lin. Ft.	4,700.	3.16	14,852	
TRAFFIC CONTROL	Lump Sum			15,500	
TOTAL					312,335
BRIDGES					
BBWA CANAL	Sq. Ft.	3,416.	10.20	34,843	
BBWA CANAL	Sq. Ft.	3,416.	10.20	34,843	
TOTAL					69,686
MISCELLANEOUS					
RIGHT-OF-WAY FENCE	Miles	9.432	2,880.00	27,164	
TRAFFIC CONTROL	Miles	4.716	400.00	1,886	
TOTAL					29,050
CONSTRUCTION SUBTOTAL					1,730,399
RIGHT OF WAY	Lump Sum				461,500
ENGINEERING & CONTINGENCIES	15% Construction Subtotal				259,560
TOTAL CONSTRUCTION COST					2,451,459

The preceding tables illustrate the estimated total construction costs. In comparing costs the time value of money is a consideration. One way to do this is by reducing each to an equivalent uniform annual cost.

Interest exists as a business fact; if you borrow money it is necessary to pay interest; if you have money you can get interest for it. It should make no difference whether money is borrowed from a bank or taxed from the pockets of citizens, the use of money must be paid for and the cost of such use is interest.

The investment opportunities outside the highway field are relevant in setting the interest rate on a highway improvement. Consider the investment opportunity that is foregone by the taxpayer who provides the funds for the highway improvement. For the many taxpayers who have to borrow money for some purpose or another (including the taxpayers, all of whom are highway users, who borrow to finance automobiles) a risk-free investment means borrowing less money or reducing the amount of the outstanding loan. For these taxpayers, a minimum rate of return for an investment would be 4%. This interest rate has been used in computing the annual costs in the following table.

CONVERSION OF TOTAL CONSTRUCTION COSTS
TO ANNUAL CONSTRUCTION COSTS

ITEM	LIFE	CAPITAL RECOVERY FACTOR*	NORTH		SOUTH	
			TOTAL COST	ANNUAL COST	TOTAL COST	ANNUAL COST
UTILITY ADJUSTMENT	40	.0505	$ 36,696	$ 1,853	$ 16,810	$ 849
GRADING	40	.0505	604,531	30,529	445,775	22,512
DRAINING	40	.0505	48,888	2,469	55,342	2,795
SURFACING	20	.0736	463,664	34,126	479,443	35,287
GRADE SEPARATION	40	.0505	261,324	13,197	321,958	16,259
INTERCHANGE	40	.0505	312,335	15,773	312,335	15,773
BRIDGES	40	.0505	--	--	69,686	3,519
MISCELLANEOUS	20	.0736	58,362	4,295	29,050	2,138
CONST. SUBTOTAL	--	--	1,785,800	102,242	1,730,399	99,132
RIGHT OF WAY	60	.0442	972,000	42,962	461,500	20,398
ENGINEERING & CONT.	20	.0736	267,870	19,715	259,560	19,104
TOTAL CONST. COST	--	--	$ 3,025,670	$164,919	$2,451,459	$138,634

* RCF for 4%

ROAD USER COSTS

The cost of vehicular operations on both routes was calculated as prescribed in the 1960 AASHO publication "Informational Report by Committee on Planning and Design Policies on Road User Benefit Analysis for Highway Improvements." The price of gasoline in Montana is higher than the national average, consequently the unit costs were adjusted from the $0.32 used in this publication to the Montana average of $0.40.

ROAD USER COSTS

LINE	% GRADE CLASSIFICATION	LENGTH IN MILES	TYPE OF OPERATION	RUNNING SPEED IN M.P.H.	1975 ADT IN EQUIVALENT VEH.*	R.U.C PER VEHICULAR MILE	ANNUAL R.U.C.
NORTH	0-3	4.166	FREE	56	7930	$0.0952	$1,147,950
SOUTH	0-3	4.716	FREE	56	7930	$0.0952	$1,299,503

* 1 Truck = 3 automobiles

MAINTENANCE

The cost of maintenance has been included on a cost-per-mile basis for each location.

MAINTENANCE COSTS

LINE	MILES	COST PER MILE	ANNUAL COST
NORTH	4.166	$3,500	$14,581
SOUTH	4.716	$3,500	$16,506

SUMMARY OF COSTS

Generally the most favorable location for a highway is the one with the lowest overall cost when the combined construction, maintenance, and operating costs have been considered. The following table shows a comparison of the costs involved:

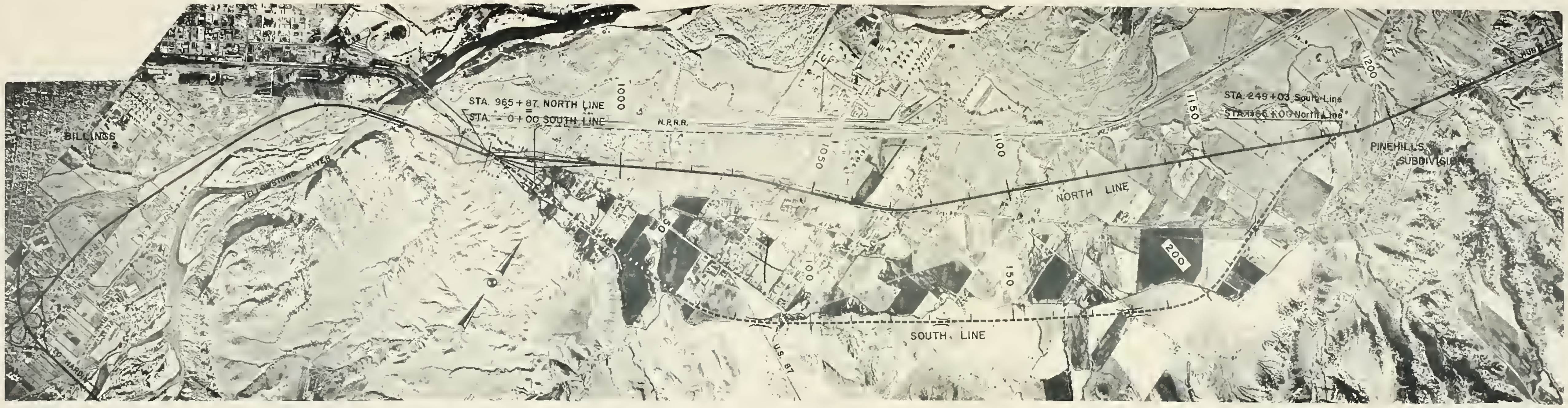
SUMMARY OF ANNUAL COSTS FOR ALTERNATE LINES

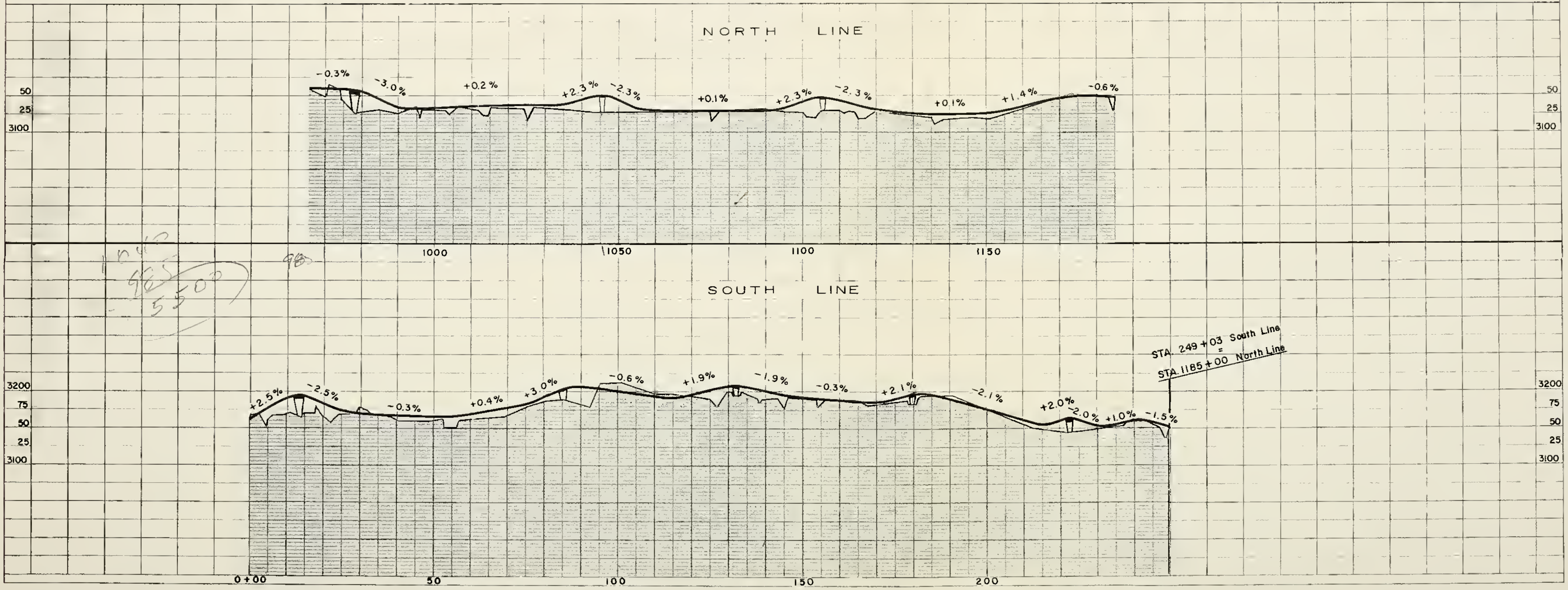
ITEM	NORTH LINE	SOUTH LINE
TOTAL CONSTRUCTION COST	$ 164,919	$ 138,634
MAINTENANCE COST	14,581	16,506
OPERATING COST	1,147,950	1,299,503
TOTAL COST	$ 1,327,450	$ 1,454,643

This summary shows that the North Line saves the highway user $1,925 annually in maintenance and $151,553 annually in vehicular operating costs. The South Line shows an annual savings of $26,285 in construction cost. However, the combination of maintenance, construction and vehicle costs shows an annual savings of $127,193 for the North Line.

CONCLUSION

On the basis of the consideration covered in this report it is concluded that the North Line would be the more favorable location for Interstate Route 94 in the Lockwood area.


BILLINGS
YELLOWSTONE RIVER
TO HARDIN
STA. 965 + 87 NORTH LINE
=
STA. 0 + 00 SOUTH LINE
N.P.R.R.
1000
1050
1100
1150
1200
50
100
150
200
U.S. 87
NORTH LINE
SOUTH LINE
STA. 249 + 03 South Line
STA. 1185 + 00 North Line
PINEHILLS SUBDIVISION
TO HUNTLEY


NORTH LINE
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SOUTH LINE
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